assisted laser desorption/ionization (MALDI)-TOF MS, with its higher resolution, is the capability of SELDI to enrich low-abundance proteins from complex matrices such as plasma, through, for example, the coupling of specific antibodies to the chip surfaces (4). Such an approach is an important methodologic aspect in “second phase” proteomics, which are characterized by repetitive investigation of the same protein to validate the protein phenotype in large population-based studies. This provides a basis for diagnostic progress in personalized medicine (5). For TTR, such an approach is relevant not only in the diagnosis of TTR-related amyloidosis but also in other diseases.

The true problem with on-chip immunopurification is not the resolution of the MS, which can be solved by use of specific available interfaces, but the efficient coupling of the antibody to the chip surface. When an on-chip immunosensor format is being used, it is important that the protein chip retains the antibody in an active state at high density. Results are greatly affected by functionality characteristics, such as the stability, affinity, and specificity of the antibody. On the basis of studies relating to microarrays, only 5%–20% of commercially available antibodies are suitable for one or the other microarray format (6).

References

Validation of a Multiplex PCR Assay for the Simultaneous Detection of Human Papillomavirus and Chlamydia trachomatis in Cervical PreservCyt Samples

To the Editor: Chlamydia trachomatis is the most common sexually transmitted bacterium worldwide (1) and a leading cause of infertility in women (2). Human papillomaviruses (HPVs) are the most important single agent causing carcinoma of the uterine cervix (3). Combined molecular screening for C. trachomatis and HPV could be justified given their propensity to cause asymptomatic infections, particularly in high-risk groups. Features of HPV infection of cells of the uterine cervix are traditionally reported by the Pap smear method (4). The introduction of liquid-based cytology, such as the ThinPrep® Pap Test™, has had the effect of improving the sensitivity of conventional cytologic screening with the potential for HPV testing of residual cellular material in borderline or difficult cases (5–7). The US Food and Drug Administration (FDA) has recently cleared a hybrid capture-based system (HCII; Digene) for screening women over 30 years of age as an adjunct to Pap testing (8). Researchers have developed consensus primers for the detection of HPV DNA by PCR (9, 10). We developed and evaluated a multiplex PCR for the simultaneous detection of HPV and C. trachomatis from PreservCyt™ (Thin-Prep) solution.

The multiplex PCR was performed on 100 cervical PreservCyt fluid specimens collected from women attending their general practitioners for routine cervical screening. We used the MY09/11 primers (9) for HPV and plasmid primers for C. trachomatis (11), which generated fragments of 450 and 201 bp, respectively. Primers for the human β-globin gene were included in the multiplex as an internal DNA amplification control, generating a 110-bp product (12) (see Fig. 1 in the Data Supplement that accompanies the online version of this Letter at http://www.clinchem.org/content/vol51/issue7/). The PCR mixture contained 5 pmol of each of the forward and reverse primers of the MY09/11 and CTP1/2 primer sets and 10 pmol of each of the forward and reverse primers of the PCO3/4 primer set, 200 μM deoxynucleoside triphosphates, 10× PCR buffer [containing 10 mM Tris-HCl (pH 8.3), 50 mM KCl], 2 mM MgCl₂, and 1 U of Platinum Taq DNA polymerase (Invitrogen Ltd.) in a final volume of 20 μL. The PCR was initiated by a 10-min denaturation and enzyme activation step at 95 °C and was completed by a 10-min extension step at 72 °C. The

Table 1. Comparison of multiplex and single PCR for the detection of HPV and C. trachomatis in PreservCyt cervical samples.

<table>
<thead>
<tr>
<th>Sample cohort</th>
<th>Multiplex positive, n</th>
<th>Single PCR positive, n</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP clinic (n = 100)</td>
<td>MY09/11</td>
<td>CTP1/2</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>GUM clinic (n = 34)</td>
<td>10</td>
<td>34</td>
</tr>
</tbody>
</table>

*Primer sets for the detection of HPV.
*Primer sets for the detection of C. trachomatis.
*Women who attended general practitioner (GP) clinics for routine cervical screening.
temperature cycles were as follows: 40 cycles of 30 s at 95 °C, 1 min at 57 °C, and 1 min at 72 °C.

The detection limit was estimated on serial dilutions, from $10^6$ to $10^1$ copies/$\mu$L of cloned HPV MY09/11 and the C. trachomatis CTP PCR product in the pCR® 2.1-TOPO® (Invitrogen Ltd). To evaluate the specificity and sensitivity of the multiplex PCR for the detection of each organism, we performed single PCRs on all samples: one PCR that detects HPV by use of the GP5+/6+ primers (10), generating a 150-bp product; and one that detects C. trachomatis by use of primers specific to the hsp60 gene of C. trachomatis (sense, 5'-GAT GTT GTT ACC GGG CGG A-3'; antisense, 5'-TAA TCG TCT TTA ACA ACC T-3'), generating a truncated version (309 bp) of a previously described product (13). PCRs were also performed with the MY09/11 and CTP1/2 primer sets singly.

In the screened population, 21% (21 of 100) of samples were positive for HPV by the multiplex PCR (Table 1). The MY09/11 primers identified 3 other samples as HPV positive that were not detected by the multiplex assay (Table 1). Either the MY09/11 or the GP5+/6+ primers confirmed all 21 of the samples positive by the multiplex assay. Two samples were positive for C. trachomatis in the multiplex assay (Table 1). These were confirmed positive by the CTP1/2 and Hsp60 primers in single PCRs, and no additional positive samples were detected. A positive sample was defined as positive by either the multiplex or any of the single PCRs for that organism. The specificity and sensitivity of the multiplex with respect to single PCR for the detection of HPV in the opportunistically screened samples were 89% (95% confidence interval, 70%–97%) and 100% (94%–100%; Table 1). The multiplex assay was 100% specific and sensitive for the detection of C. trachomatis with respect to single PCR in the screened population (Table 1).

To estimate the diagnostic sensitivity of the multiplex assay for the detection of C. trachomatis, we performed multiplex PCR on 34 Preserv-